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## EUROPEAN PATENT APPLICATION

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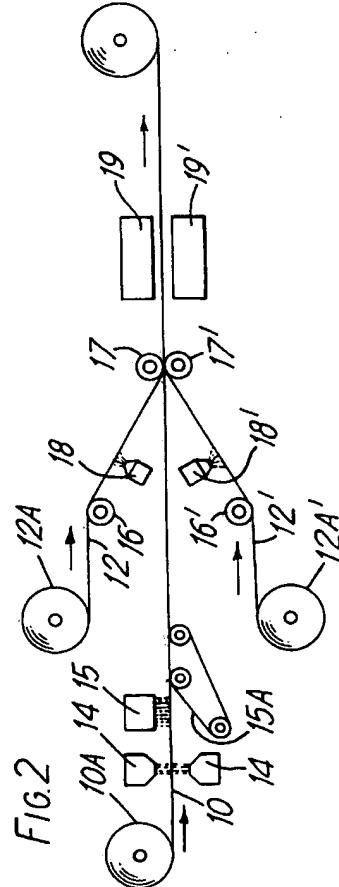
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㉓ Liquid absorbent composite laminate.

㉔ A disposable, cloth-like towel of superior wet strength and absorbency comprises a scrim at least one face of which is coated with a superabsorbent material and a nonwoven cellulosic web which is bonded to the coated scrim. The superabsorbent coating preferably is formed by wetting the scrim with water or an aqueous adhesive, applying a solid hydrophilic polymer to the scrim, then applying a nonwoven absorbent cellulosic web to the coated scrim and drying the resulting composite web. Bonding of the scrim to the cellulosic web can be achieved by applying an adhesive to the side of the cellulosic web which is brought into contact with the coated scrim. Alternatively, both the hydrophilic coating and bonding can be effected by sandwiching the scrim, coated with an unreacted mixture of hydrophilic polymer and crosslinking compound, between two cellulosic layers and then subjecting the multi-ply sheet to crosslinking reaction conditions to form the superabsorbent on the scrim as well as to cause adhesion of the cellulosic webs thereto.



EP 0 506 336 A1

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This invention relates to a superabsorbent cloth-like laminate structure and to its method of preparation. In one of its more specific aspects, this invention relates to a scrim-reinforced, cloth-like, composite liquid absorbent laminate structure comprising a superabsorbent material associated with scrim and covered on at least one side with a nonwoven cellulosic web. In another of its more specific aspects, the invention includes a scrim-reinforced composite laminate in which the scrim is coated with solid absorbent and sandwiched between layers of non-woven cellulosic webs. Other aspects of this invention relate to the method of manufacture of the structure and to consumer products incorporating such structures as an element thereof. The resulting structures are both highly absorbent and resistant to tear.

#### Background of the Invention

The novel cloth-like fibrous laminate is useful as disposable toweling, bed pads, diaper liners, sanitary napkins, wipes, wound dressings, and filter materials which are capable of removing moisture from non-aqueous filtrates. In one of its preferred embodiments, a composite fabric comprising a superabsorbent scrim layer sandwiched between layers of dry laid nonwoven cellulosic fibers is produced as a strong laminate structure of high liquid-absorbency which is soft to the touch.

Numerous proposals have been made for the manufacture of cellulosic composite products useful as disposable towels and similar products. Two desirable properties of absorbent paper products, namely, high-liquid absorbency and superior wet strength are virtually antithetical. High absorbency is usually associated with a fibrous structure of high porosity but low tensile strength, whereas wet strength usually involves the use of binders or compacted fibers exhibiting relatively low absorbency.

A method for the manufacture of a cloth-like composite laminate is disclosed in U.S. Patent No. 4,634,621 to Manning et al, in which scrim coated with a thermoplastic binder is inserted between two nonwoven layers bonded with a latex adhesive and the composite heated to a temperature sufficient to activate the thermoplastic binder. A scrim reinforced, cloth-like composite laminate is produced having both excellent dry and wet strength properties.

A number of patents are directed to methods for incorporating superabsorbent materials, commonly referred to in the art as SAM's into cellulosic composites to form products of greatly enhanced absorbency for liquids. For example, Korpman, U.S. 4,413,995 discloses an absorbent panel structure useful in various hygienic products in which a paper or fabric substrate is coated with a reactive composition of a liquid polyhydroxy organic compound and a particulate wa-

ter-insoluble, water swellable absorbent polymer. Watt, in U.S. Patent 4,600,462, discloses a latex bonded, air laid web of enhanced absorbency to which a water soluble hydrophile is added and dried on the web. An absorbent pad assembly in which a hydrophilic polymer coating is applied to one surface of one pad and covered with another pad adjacent the coated surface is disclosed in U.S. 4,461,621 to Karami et al.

In accordance with this invention, a strong disposable absorbent laminate of improved water absorbency is formed by incorporating a superabsorbent material on a scrim, e.g. a polyester or fiberglass scrim, and covering the scrim with a layer of cellulosic fibers. In one specific embodiment of the invention, the scrim is coated with an adhesive, e.g. a polyvinyl alcohol latex, to which superabsorbent powder is added to form a coating on one or both sides of the scrim, and the thus formed superabsorbent scrim is covered with a web of cellulose fibers. The resultant product is a strong laminate structure with superior water absorbency and a cloth-like appearance and feel.

#### Summary of the Invention

In accordance with a preferred embodiment of this invention, a cloth-like composite laminate is formed which comprises two nonwoven layers of cellulosic fibers attached to the opposite sides of a scrim or screen which has been coated or impregnated with a superabsorbent hydrophilic polymer.

A number of superabsorbent polymers are known in the art. U.S. Patent No. 4,600,458 to Kramer et al., for example, includes a long list of patents disclosing superabsorbent polymers useful in absorbent structures in which the superabsorbent polymers are incorporated into an absorbent fibrous web or laminate. Among the polymers disclosed for this purpose are saponified starch-polyacrylonitrile graft copolymers, crosslinked/grafted cellulose, saponified vinyl acetate-acrylic acid copolymers, starch grafted polyvinyl acetate, acrylic acid polymers, crosslinked polyethylene oxide, and the like. In the method of this patent, superabsorbent solid particles are layered between webs of fibrous material and the layered stacks of webs crimped to retain the solid absorbent in place. McFarland et al., U.S. Patent No. 4,655,757 incorporates solid particles of superabsorbent material into a coformed layer of meltblown fibers containing wood fibers for improved absorbency. Among the superabsorbents mentioned therein are those formed from hydrolyzed cross-linked polyacrylamides, polyacrylates, polymers of acrylic polymers or their copolymers. Sodium polyacrylate hydrocolloid particles are preferred as superabsorbents.

Fibrous slivers and absorbent structures having superabsorbents or hydrocolloids distributed therethrough are disclosed in U.S. Patent No. 4,340,556 to

Ciencewicki and U.S. Patent No. 4,596,567 to Iskra wherein some superabsorbents are described as having a backbone of natural or synthetic polymers with hydrophilic groups, or polymers containing hydrophilic groups, chemically bonded thereto or in intimate admixture therewith. Among the superabsorbents mentioned therein are modified natural and regenerated polymers, such as polysaccharides including cellulose, and starch and regenerated cellulose which are modified by being carboxylated, phosphonoalkylated, sulfoalkylated, or phosphorylated to render them highly hydrophilic. These polymers may be cross-linked to render them water insoluble, all as described in U.S. Patent No. 4,105,033 to Chatterjee et al.

The superabsorbent polymer and cross linker may be any of those already known in the chemical literature as well as those resulting from continued research and development to produce water insoluble cross linked polymer products of enhanced hydrophilic propensity. Currently, superabsorbents suitable for application to the scrim used in the toweling of this invention include the metal ion crosslinked polymers described in U.S. Patent 4,090,013 and a polyacrylate absorbent containing both amide and carboxylate groups prepared by radiation polymerization and crosslinking as described in U.S. Patent 4,192,727. Hydrophilic polymers that are reacted with organic crosslinkers as described in the U.S. Patent 4,310,593 are further examples of superabsorbents that may be applied to the scrim.

The scrim is formed of a continuous filament of nonwoven material such as rayon, nylon, polyester, polypropylene, aramids, and glass. A polyester scrim or screen sold under the trademark Bayex by Bay Mills, Ltd., of Canada is illustrative of a desirable reinforcement for production of the novel toweling of high wet strength and superior water absorbency. The scrim will in most cases have a mesh opening of 2 to 5 mm between fibers and will contribute a weight in the range of 0.2 to 2.0 ounces per square yard to the total weight of the multi-ply towel.

The two layers of nonwoven cellulosic fibers which are attached to the opposite sides of the superabsorbent coated scrim or screen may be produced by any of the many known procedures. For example, previously mentioned U.S. Patent No. 4,634,621, incorporated herein by reference, discloses an operation in which dry fibers are laid on two separate belts and bonded with a latex adhesive forming two separate air laid bonded cellulosic webs which are then brought into contact with the opposite sides of a scrim coated with a thermoplastic resin. In the process of this patent, the scrim has a thermoplastic polymer binder applied as a coating to each of its two sides. The nonwoven cellulosic layers and the intermediate binder-coated scrim are finally passed through a heated lamination station to cause adhe-

sion of the cellulosic layers to the scrim.

In accordance with a preferred embodiment of this invention, each of the cellulosic webs which is brought into contact with the scrim is given a coating of binder on its surface nearest the scrim so that surface fibers of each nonwoven layer become attached on contact with the superabsorbent scrim and on curing of the binder, the cellulosic layers are bonded to the scrim to provide a unitary product of high wet strength and greatly enhanced absorbency.

Alternatively, it is in many cases preferable to bring the nonwoven cellulosic layers into contact with the scrim immediately after the hydrophilic polymer has been applied thereon. In such cases, the wet surface coating on the scrim contacts the cellulosic layers and during the drying or curing reaction creates a bonding of the cellulosic layers to the scrim.

#### Brief Description Of The Drawings

To facilitate the further description and understanding of the invention, reference will be made to the accompanying drawings in which:

FIG. 1 is a fragmentary sectional view of a multi-ply cloth-like laminate according to the invention; FIG. 2 is a schematic diagram showing the apparatus used in the method of making the product illustrated in FIG. 1; and FIG. 3 is a schematic diagram showing alternative apparatus for the manufacture of a superabsorbent product by the method of this invention.

#### Description of Preferred Embodiments

A typical cross section of the product of the invention is illustrated in Fig. 1 wherein scrim 10 coated on both sides with superabsorbent material 11 is sandwiched between, and bonded to, two nonwoven cellulosic webs 12 coated with bonding material 13. The superabsorbent material 11 on the opposite sides of scrim 10 and the bonding material 13 on the inner surfaces of cellulosic layers 12 contiguous to scrim 10 hold the multi-ply sheet together to provide a disposable, cloth-like towel of superior absorbency and wet strength. Bonding material 13 may take different forms and different methods of application as illustrated in Figs. 2 and 3.

The nonwoven cellulosic webs 11 may be formed from air laid cellulose fibers by methods well known in the art, for example, by the method and apparatus disclosed in U.S. Patent No. 3,797,074 U.K. Patent 2,008,638B; or U.S. Patents 4,014,615; 4,191,751; and 4,285,647, incorporated by reference herein.

With reference to Fig. 2, scrim 10 from roll 10A is passed between sprays 14 which apply water or a suitable adhesive, e.g. a solution of carboxymethyl cellulose to both sides of the scrim. The coated scrim 10 then passes through station 15 where powdered

superabsorbent material is added to the scrim and held in place by the adhesive as the scrim passes over a belt 15A which presses solid absorbent material passing through openings in the scrim against the side opposite the powder applicator 15, thus coating both sides of the scrim with superabsorbent powder which is held in place by the water or adhesive on the scrim.

Simultaneously, two nonwoven air laid cellulosic webs 12 and 12' are supplied from a suitable source 12A, 12A' over rollers 16 and 16' into the nip of opposed rollers 17 and 17' where they meet and sandwich scrim 10 laden with superabsorbent 11 between them. Before entering the nip between rollers 17 and 17', each of cellulosic layers 12 and 12' is sprayed with a bonding agent adhesive by jets 18 and 18' on the side of each layer that is to brought into contact with scrim 10. The multi-ply sheet then passes through drying station 19 which hastens the bonding of cellulosic layers 12 and 12' to absorbent-coated scrim 10.

In Fig. 3, illustrating apparatus similar to that of Fig. 1, scrim 10 passes over roller 20 and under rollers 21 which are partially immersed in water or adhesive solution in tank 22. The thus impregnated scrim 10 is then drawn from tank 22 over roller 23, dusted with superabsorbent powder from distributor 15 and into the nip of opposed rollers 17 and 17'. Thence, the multi-ply sheet passes through drying station 24 bonding the cellulosic layers 12 to the opposite sides of scrim 10.

The weight of the cellulosic fibers forming each nonwoven layer is within the range of 20 pounds/ream to 50 pounds/ream. The separate layers containing the cellulosic fibers can be formed by air laying or foam laying the cellulosic fibers onto various belts known in the art. One type of apparatus for air forming each layer of cellulosic fibers is shown in U.S. Patent No. 4,193,751 to Miller. Other techniques known in the art can also be used such as foam forming as described in U.S. Patent No. 3,837,999 to Chung or air emulsion as disclosed in U.S. Patent No. 4,049,491 to Brandon et al.

The latex adhesive, used to bind together the three dimensional cellulosic fibers in each nonwoven layer, can be selected from various latex adhesives known in the art. Acceptable latex adhesives include acrylate emulsions, butadiene-styrene emulsions, acetate-ethylene emulsions, and acrylonitrile-butadiene emulsions. An especially effective latex adhesive is acetate-ethylene which is sold under the trademark AIRFLEX A-106 by Air Products, Inc. of Pennsylvania. The skilled artisan can select the particular latex adhesive depending upon the type of cellulosic fibers that are to be bonded. The latex adhesive is applied by known techniques, e.g., by spraying or foaming. The amount of solids deposited from the latex adhesive depends, *inter alia*, on the

weight of the cellulosic fibers in each layer. Generally, latex adhesives having from 15 to 25% solids are used.

After the latex adhesive is applied to the cellulosic fibers, the latex adhesive is dried by conventional techniques. As a result, two separate nonwoven layers of cellulosic fibers are formed.

The scrim is preferably a continuous filament scrim composed of a nonwoven material, such as nylon, rayon, polyester, polypropylene, glass, and aramids, such as Kevlar and Nomex which are trademarks of the E.I. DuPont de Nemours & Co. An example of a bonded polyester nonwoven material useful as scrim is Bayex, which is a trademark of Bay Mills, Ltd. Such a scrim can have dimensions of 4 threads per inch of 150 denier in the cross machine direction (CD) and 12 threads per inch of 70 denier in the machine direction (MD). The weight of the scrim is preferably within the range of 0.2 ounce per square yard to 2.0 ounces per square yard. Other scrims, such as a mesh scrim, can also be used in the present invention.

The preferred nonwoven material for the scrim has a set of spaced machine direction threads with a second set of spaced threads lying cross-directionally with respect to the first set of threads. The two sets of threads are bound or adhered together at the points where the threads of one set cross the threads of another set. The threads making up the scrim can be in an over and under configuration, as shown in U.S. Patent No. 3,885,279 to Damell et al, or a one side pattern, as shown in U.S. Patent No. 2,902,395 to Hirschy et al. Other scrim configurations known in the art, such as extended netting described in U.S. Patent No. 4,152,479 to Larsen, can also be used.

The scrim is coated with a thermoplastic binder so that the two nonwoven layers of cellulosic fibers adhere to the scrim, when the scrim is inserted between the two nonwoven layers. Examples of acceptable thermoplastic polymer binders include polyvinyl chloride plastisol, polyvinyl chloride, polyvinyl acetate, ethylene acrylic acid and ethylene vinyl acetate. Other known thermoplastic binders can also be used. An especially effective polyvinyl chloride plastisol is sold under the trademark BAYEX F-50 by the Bay Mills, Ltd. of Canada.

The skilled artisan can select the particular thermoplastic polymer binder depending upon the type of cellulosic fibers and the scrim that are to be bound together. The scrim can be coated with the thermoplastic polymer binder by various known techniques.

After the scrim is inserted between the two nonwoven layers of cellulosic fibers, the scrim and the two nonwoven layers are heated to a temperature sufficient to activate the thermoplastic binder so as to laminate together the scrim and the nonwoven layers. The heating of the scrim and the nonwoven layers is performed without pressing the scrim and the nonwoven

layers together.

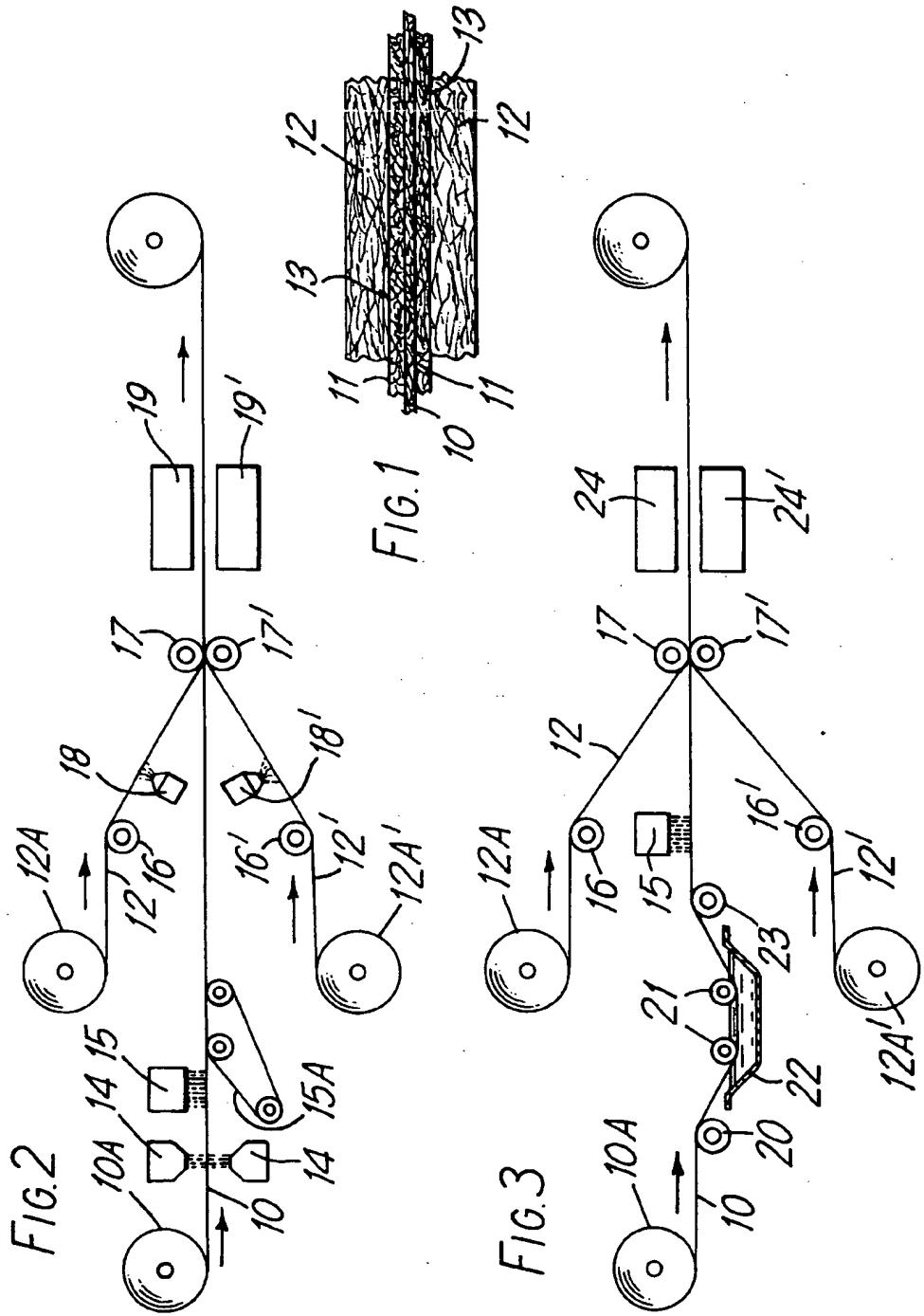
The heating procedure is preferably performed by passing hot air through the two nonwoven layers and the scrim, in a manner shown in FIG. 2, or by passing the two nonwoven layers and the scrim over a large diameter, heated drum, as shown in FIG. 3. Other heating techniques, however, known in the art can also be used to bind the two separate nonwoven layers of cellulosic fibers onto opposite sides of the scrim.

Those skilled in the art know that there are numerous hydrophilic polymers which may be crosslinked with or without crosslinking agents and which are suitable for use to provide the superabsorbent coating on the scrim pursuant to this invention. U.S. Patent No. 4,461,621 lists several patents which teach the formation of superabsorbent coatings that are useful in the present invention. Ionizing radiation may be used to accelerate the cross-linking reaction with or without the application of heat from an external source.

The embodiments of the invention which have been described are exemplary of others which will be apparent to those skilled in the art without departing from the scope and spirit of the invention. Accordingly, only such limitations should be imposed on the invention as are set forth in the appended claims.

### Claims

1. A method of making a liquid absorbent composite laminate having high wet strength and enhanced absorbency which comprises:
  - (a) coating a scrim with a superabsorbent hydrophilic polymer, and
  - (b) bonding the coated scrim to an absorbent nonwoven cellulosic web.
2. A method as claimed in Claim 1 characterised in that bonding is effected by applying an adhesive to the side the cellulosic web which is brought into contact with the coated scrim and then heating said cellulosic web and the coated scrim to bond the web to the coated scrim.
3. A method as claimed in Claim 1 or Claim 2 characterised in that the scrim is wet with water and then coated with a powdered solid hydrophilic polymer prior to bonding the coated scrim to the cellulosic web.
4. A method as claimed in Claim 3 characterised in that the water contains a water soluble adhesive.
5. A method as claimed in Claim 1 characterised in that the superabsorbent coating and bonding is effected by coating the scrim with a liquid hydrophilic polymer, covering both sides of thecoated scrim with absorbent cellulosic webs and the hydrophilic polymer coating on said scrim is crosslinked in situ by heat or ionizing radiation causing crosslinking of the polymer and bonding of the scrim to the cellulosic webs.
6. A liquid absorbent composite laminate having high wet strength and enhanced absorbency which comprises a scrim, a superabsorbent coating on said scrim, and a nonwoven cellulosic layer bonded to the said scrim.
7. A liquid absorbent laminate as claimed in Claim 6 wherein both sides of the scrim are coated with solid superabsorbent and bonded to nonwoven cellulose webs.
8. A liquid absorbent composite laminate which comprises a scrim, a solid superabsorbent coating on at least one side of the scrim, and an absorbent nonwoven cellulosic web bonded to the scrim and covering the superabsorbent on the coated side of the scrim.
9. A liquid absorbent laminate as claimed in claim 8 wherein both sides of the scrim are coated with a solid superabsorbent and an absorbent nonwoven cellulosic fibrous web is bonded to each side of the scrim.
10. A liquid absorbent laminate as claimed in Claim 8 or Claim 9 wherein the scrim is a woven polyester screen and the cellulosic fibrous web is an air laid cellulose sheet bonded with latex on the side adjacent the scrim.





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## EUROPEAN SEARCH REPORT

Application Number

EP 92 30 2525

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.5)		
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim			
D, Y	US-A-4 634 621 (MANNING ET AL) * the whole document * ----	1,6-10	B32B/26 A61F13/15		
D, Y	US-A-4 461 621 (KARAMI ET AL) * the whole document * ----	1,6-10			
A	US-A-4 715 918 (LANG) * the whole document * -----	1,3			
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)		
			B32B A61F		
The present search report has been drawn up for all claims					
Place of search	Date of completion of the search	Examiner			
THE HAGUE	23 JUNE 1992	DE JONGE S.J.P.			
CATEGORY OF CITED DOCUMENTS					
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I : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons A : member of the same patent family, corresponding document					

